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the semiconductor laser.

However, these connecting methods require precision components, and accurate alignment requires proficiency. Therefore, the operation is impractical. This has caused the conventional optical fiber to be expensive.

The present invention was made in light of the conventional problems, and one of its objects is to provide (i) an optical fiber connector in which an optical axis of the optical fiber can be easily held at the center of the optical fiber connector with high accuracy, and (ii) a manufacturing method thereof, and (iii) a use thereof. Another object is to provide (i) an optical fiber connector that allows for easy and accurate alignment of optical axes, (ii) a manufacturing method thereof, and (iii) a use thereof.

DISCLOSURE OF INVENTION

The present inventors diligently studied a method for holding a fiber at the center of a connector main body, whereby the optical axis of the fiber is not displaced from the center. As a result, the present inventors found a way to accurately hold the fiber at the center of the connector main body without misaligning the optical axis. This was achieved by constructing the connector main body by combining a plurality of metal pipes with one another, instead of implanting the fiber in resin filling the connector main body as conventionally done. In this way, the present invention was accomplished.

Namely, to achieve the objects, an optical fiber connector, of the present invention, in which a lens is formed at a resin injection portion located at a front end of an optical fiber inserted in a connector main body, wherein the connector main body includes a first pipe for receiving the optical fiber inside, and a second pipe for receiving the first pipe inside.

different. As above, in the case where the lens is formed by using two kinds of resins whose refractive indexes are different from each other, it is possible to further reduce the volume shrinkage and improve the light converging property.

Further, it is preferable that the first resin and the second resin are ultraviolet-hardened resins, and are hardened by irradiation of ultraviolet light.

In the case where the light hardening resin such as the ultraviolet hardened resin is used as the first resin and the second resin, it is possible to harden the resin only by irradiating ultraviolet (UV) light onto the ultraviolet hardened resin injected into the resin-injection portion. That is, in the case where the ultraviolet hardened resin is used, it is unnecessary to heat the resin to harden it after irradiation of UV light. Therefore, it is possible to simplify manufacturing steps as compared with the case that the thermosetting resin is used.

It is preferable in the second resin hardening step that, in the second resin hardening step, a wavefront aberration of light that has transmitted through the pre-lens is measured, and the lens is so shaped as to have a wavefront aberration close to 0.

According to the invention, in the second resin hardening step, the second resin is hardened into a shape that will bring the wavefront aberration of transmitted light through the pre-lens to be close to 0. In this way, as described above, the adverse effect of the volume shrinkage can be decreased. Therefore, unlike the conventional examples, it is possible to harden the second resin without taking into account the volume shrinkage beforehand.

An optical connecting apparatus of the present invention includes (i) a light source or optical information output means for outputting optical information; (ii) an optical fiber connector

CLAIMS:

1. An optical fiber connector in which a lens is formed at a resin injection portion located at a front end of an optical fiber inserted in a connector main body,

wherein the connector main body includes a first pipe for receiving the optical fiber inside, and a second pipe for receiving the first pipe inside.

2. The optical fiber connector as set forth in Claim 1, wherein the connector main body is made of stainless steel.

3. The optical fiber connector as set forth in Claim 1 or 2, wherein the lens is made from a plurality of resins having different refractive indexes.

4. The optical fiber connector as set forth in Claim 3, wherein a resin with the largest refractive index among the plurality of resins defines a surface of the lens.

5. A method for manufacturing an optical fiber connector in which a lens is formed at a resin injection portion located at a front end of an optical fiber inserted in a connector main body,

said method comprising:

a connector forming step of forming the connector main body by inserting a first pipe in a second pipe, wherein the first pipe receives the optical fiber inside, and the second pipe receives the first pipe inside;

a fiber inserting step of inserting the optical fiber in the first pipe of the connector main body formed in the connector forming step; and

a lens forming step of forming a lens by injecting a

light-hardened resin or a thermosetting resin in the resin injection portion.

6. The method as set forth in Claim 5, wherein:

said lens forming step includes:

a first resin injecting and hardening step of injecting a first resin, made from a light-hardened resin or a thermosetting resin, into the resin injection portion, and hardening the first resin;

a second resin injecting step of injecting a second resin, made from a light-hardened resin or a thermosetting resin, onto the hardened first resin so as to form a pre-lens; and

a second resin hardening step of hardening the second resin so as to form the lens.

7. The method as set forth in Claim 6, wherein the second resin has a higher refractive index than the first resin.

8. The method as set forth in Claim 6 or 7, wherein the first resin and the second resin are UV-hardened resins, and are hardened by irradiation of ultraviolet light.

9. The method as set forth in any one of Claims 6 through 8, wherein in said second resin hardening step, a wavefront aberration of light that has transmitted through the pre-lens is measured, and the lens is so shaped as to have a wavefront aberration close to 0.

10. An optical coupling apparatus, comprising:

a light source or optical information output means for outputting optical information;

an optical fiber connector as set forth in any one of Claim

1 through 4 for optically coupling with emitted light from the light source or the optical information output means; and

setting means having a groove for setting the optical fiber connector and the light source or the optical information output means thereon.